



NLT Technologies, Ltd.

TFT COLOR LCD MODULE

NL204153AC21-17

54cm (21.3 Type)

QXGA

LVDS interface (4 ports)

DATA SHEET

DOD-PP-1621 (2nd edition)

**This DATA SHEET is updated document from
DOD-PP-1539(1).**

**All information is subject to change without notice.
Please confirm the sales representative before
starting to design your system.**



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INTRODUCTION

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The products are classified into three grades: "**Standard**", "**Special**", and "**Specific**".

Each quality grade is designed for applications described below. Any customer who intends to use a product for application other than that of Standard is required to contact an NLT sales representative in advance.

The **Standard**: Applications as any failure, malfunction or error of the products are free from any damage to death, human bodily injury or other property (Products Safety Issue) and not related the safety of the public (Social Issues), like general electric devices.

Examples: Office equipment, audio and visual equipment, communication equipment, test and measurement equipment, personal electronic equipment, home electronic appliances, car navigation system (with no vehicle control functions), seat entertainment monitor for vehicles and airplanes, fish finder (except marine radar integrated type), PDA, etc.

The **Special**: Applications as any failure, malfunction or error of the products might directly cause any damage to death, human bodily injury or other property (Products Safety Issue) and the safety of the public (Social Issues) and required high level reliability by conventional wisdom.

Examples: Vehicle/train/ship control system, traffic signals system, traffic information control system, air traffic control system, surgery/operation equipment monitor, disaster/crime prevention system, etc.

The **Specific**: Applications as any failure, malfunction or error of the products might severe cause any damage to death, human bodily injury or other property (Products Safety Issue) and the safety of the public (Social Issues) and developed, designed and manufactured in accordance with the standards or quality assurance program designated by the customer who requires extremely high level reliability and quality.

Examples: Aerospace system (except seat entertainment monitor), nuclear control system, life support system, etc.

The quality grade of this product is the "**Standard**" unless otherwise specified in this document.

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL204153AC21-17 is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight.

The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

Color data signals from a host system (e.g. signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

1.2 APPLICATION

- Color monitor system

1.3 FEATURES

- Ultra-wide viewing angle (Super Fine TFT (SFT))
- Wide color gamut
- High luminance
- High contrast
- Low reflection
- 1,024 gray scale in each R, G, B sub-pixel (10-bit), 1,073,741,824 colors
- LVDS interface
- Small foot print
- Long life LED backlight type with an LED driver board
- Acquisition product for UL60950-1/CSA C22.2 No.60950-1-03 (File number: E170632)
- Compliance with the European RoHS directive (2011/65/EU)



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2. GENERAL SPECIFICATIONS

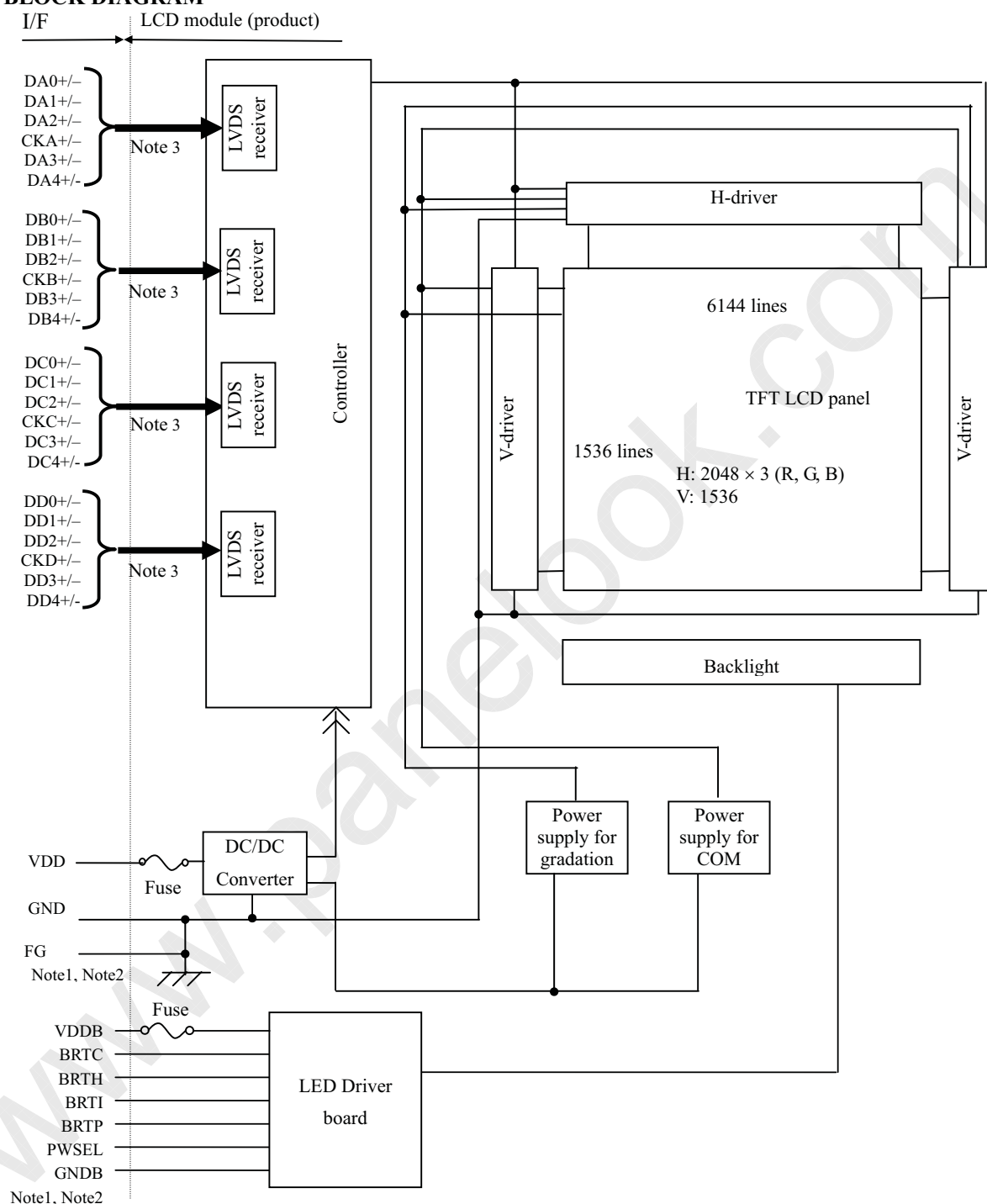
Display area	433.152 (H) × 324.864 (V) mm
Diagonal size of display	54cm (21.3 inches)
Drive system	a-Si TFT active matrix
Display color	1,073,741,824 colors
Pixel	2,048 (H) × 1,536 (V) pixels (1 pixel consists of 3 sub-pixels (RGB).)
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Sub-pixel pitch	0.0705 (H) × 0.2115 (V) mm
Pixel pitch	0.2115 (H) × 0.2115 (V) mm
Module size	457.0 (W) × 350.0 (H) × 21.5 (D) mm (typ.)
Weight	2,700g (typ.)
Contrast ratio	1,400:1 (typ.)
Viewing angle	At the contrast ratio $\geq 10:1$ • Horizontal: Right side 88° (typ.), Left side 88° (typ.) • Vertical: Up side 88° (typ.), Down side 88° (typ.)
Designed viewing direction	Viewing angle with optimum grayscale ($\gamma \approx \text{DICOM}$): Normal axis (perpendicular) Note1
Polarizer surface	Antiglare
Polarizer pencil-hardness	2H (min.) [by JIS K5600]
Color gamut	At LCD panel center 72 % (typ.) [against NTSC color space]
Response time	$T_{on} + T_{off}$ (10% $\leftrightarrow$ 90%) 40ms (typ.)
Luminance	At the maximum luminance control 800cd/m ² (typ.)
Signal system	4 ports LVDS interface. (Characteristics of AC receiver THC63LVD104S×2pcs, THine Electronics, Inc. or equivalent) [RGB 10-bit signals, Data enable signal (DE), Dot clock (CK)]
Power supply voltage	LCD panel signal processing board: 12.0V LED driver board: 12.0V
Backlight	LED backlight type with LED driver board
Power consumption	At checkered flag pattern, the maximum luminance control 58.0W (typ.)

Note1: When the product luminance is 450cd/m², the gamma characteristic is designed to $\gamma \approx \text{DICOM}$.

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3. BLOCK DIAGRAM



Note1: Relations between GND (Signal ground), FG (Frame ground) and GNDB (LED driver board ground) in the LCD module are as follows.

GND - FG	Connected
GND - GNDB	Not connected
FG - GNDB	Not connected

Note2 GND, FG and GNDB must be connected to customer equipment's ground, and it is recommended that these grounds be connected together in customer equipment.

Note3 Each pair of the LVDS signal has a 100Ω terminating resistance between D+ and D-.



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4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	457.0 ±0.5 (W) × 350.0 ± 0.5 (H) × 21.5 (typ., D) 23.0 (max. D) Note1, Note2	mm
Display area	433.152 (H) × 324.864 (V) Note2	mm
Weight	2,700 (typ.), 2,980 (max.)	g

Note1: Excluding warpage of the cover for LED driver board.

Note2: See "8. OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter			Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board		VDD	-0.3 to +14.0	V	-
	LED driver board		VDDB	-0.3 to +15.0	V	
Input voltage for signals	LCD panel signal processing board Note1		Vi	-0.3 to +2.8	V	VDD= 12.0V
	LED driver board	BRTI signal	VBI	-0.3 to +1.5	V	VDDB= 12.0V
		BRTP signal	VBP	-0.3 to +5.5	V	
		BRTC signal	VBC	-0.3 to +5.5	V	
		PWSEL signal	VBS	-0.3 to +5.5	V	
Storage temperature Note6			Tst	-20 to +60	°C	-
Operating temperature Note6		Front surface	TopF	0 to +60	°C	Note2
		Rear surface	TopR	0 to +60	°C	Note3
Relative humidity Note4 Note6			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40°C < Ta ≤ 50°C
				≤ 70	%	50°C < Ta ≤ 55°C
Absolute humidity Note4 Note6			AH	≤ 73 Note5	g/m ³	Ta > 55°C
Operating altitude			-	≤ 5,100	m	0°C ≤ Ta ≤ 55°C
Storage altitude			-	≤ 13,600	m	-20°C ≤ Ta ≤ 60°C

Note1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, DA4+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, DB4+/-, CKB+/-, DC0+/-, DC1+/-, DC2+/-, DC3+/-, DC4+/-, CKC+/-, DD0+/-, DD1+/-, DD2+/-, DD3+/-, DD4+/-, CKD+/-, BSEL.

Note2: Measured at LCD panel surface (including self-heat)

Note3: Measured at LCD module's rear shield surface (including self-heat)

Note4: No condensation

Note5: Water amount at Ta= 55°C and RH= 70%

Note6: The image quality may cause degradation in case of rapid change humidity and temperature.

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4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	10.8	12.0	13.2	V	-
Power supply current		IDD	-	590 Note1	980 Note2	mA	at VDD= 12.0V
Permissible ripple voltage		VRP	-	-	100	mVp-p	for VDD
Differential input threshold voltage	High	VTH	-	-	+100	mV	at VCM= 1.2V Note3, Note4
	Low	VTL	-100	-	-	mV	
Input voltage swing		VI	0	-	2.4	V	Note4
Terminating resistance		RT	-	100	-	Ω	-

Note1: Checkered flag pattern (by EIAJ ED-2522)

Note2: Pattern for maximum current

Note3: Common mode voltage for LVDS driver

Note4: DA0+/-, DA1+/-, DA2+/-, DA3+/-, DA4+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, DB4+/-, CKB+/-, DC0+/-, DC1+/-, DC2+/-, DC3+/-, DC4+/-, CKC+/-, DD0+/-, DD1+/-, DD2+/-, DD3+/-, DD4+/-, CKD+/-

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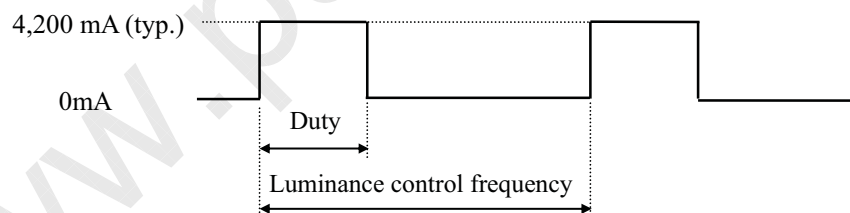
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4.3.2 LED Driver board

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDDB	11.4	12.0	12.6	V	-
Power supply current		IDDB	-	4,200	5,800	mA	VDDB= 12.0V, At the maximum luminance control
Input voltage for signals	BRTI signal		VBI	0	-	1.0	V
	B RTP signal	High	VBPH	2.0	-	5.25	V
		Low	VBPL	0	-	0.8	V
	BRTC signal	High	VBCH	2.0	-	5.25	V
		Low	VBCL	0	-	0.8	V
	PWSEL signal	High	VBSH	2.0	-	5.25	V
		Low	VBSL	0	-	0.8	V
Input current for signals	BRTI signal		IBI	-200	-	-100	μA
	B RTP signal	High	IBPH	-	-	1,000	μA
		Low	IBPL	-600	-	-	μA
	BRTC signal	High	IBCH	-	-	300	μA
		Low	IBCL	-300	-	-	μA
	PWSEL signal	High	IPSH	-	-	1,000	μA
		Low	IPSL	-600	-	-	μA

4.3.3 LED Driver board current wave



Duty: At the maximum luminance control 100% to at the minimum luminance control 1%.
Luminance control frequency: 270Hz (typ.)

Note1: Luminance control frequency indicate the input pulse frequency, when select the external pulse control. See "4.6.2 Detail of B RTP timing".

Note2: The power supply lines (VDDB and GNDB) have large ripple voltage during luminance control. See "4.3.4 Power supply voltage ripple".

There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on. Put a capacitor (5,000 to 6,000μF) between the power supply lines (VDDB and GNDB) to reduce the noise, if the noise occurred in the circuit.

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4.3.4 Power supply voltage ripple

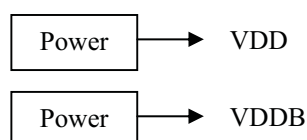
This product works, even if the ripple voltage levels are beyond the permissible values as following the table, but there might be noise on the display image.

Power supply voltage		Ripple voltage (Measure at input terminal of power supply)	Note1	Unit
VDD	12.0V	≤ 100		mVp-p
VDDDB	12.0V	≤ 200		mVp-p

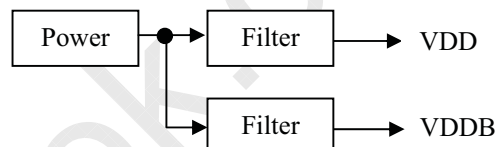
Note1: The permissible ripple voltage includes spike noise.

Example of the power supply connection

a) Separate the power supply



b) Put in the filter



4.3.5 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDD	FCC16202AB	KAMAYA ELECTRIC Co., Ltd.	2.0 A	4.0A, 5 seconds maximum	Note1
			32 V		
VDDb	CCF1N10	KOA Corporation	10 A	20 A, 1 seconds maximum	
			60 V		
	TF16AT5.00T		5.0 A	10 A, 5 seconds maximum	
			32 V		

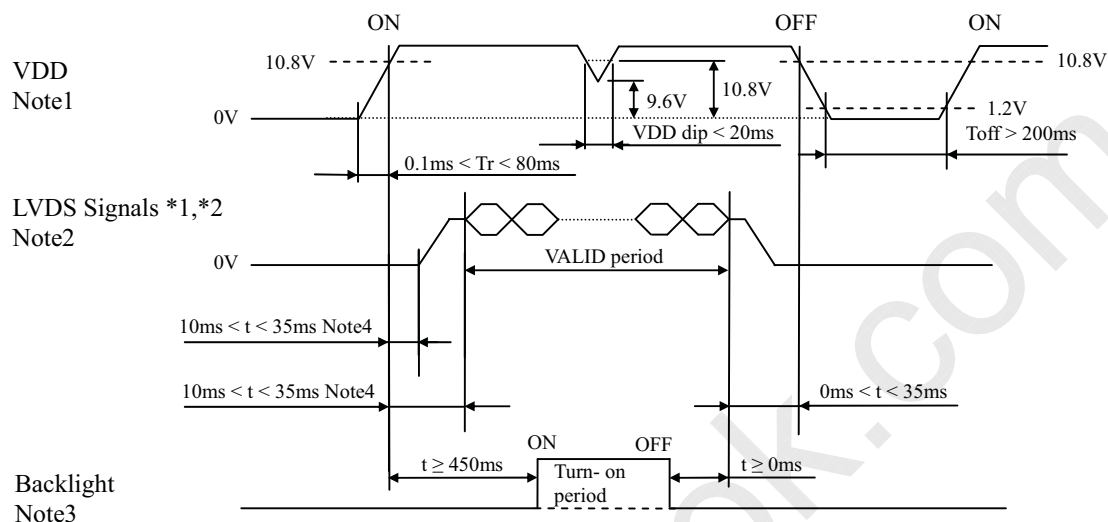
Note1: The power supply capacity should be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

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4.4 POWER SUPPLY VOLTAGE SEQUENCE

4.4.1 LCD panel signal processing board



*1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, DA4+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, DB4+/-, CKB+/-, DC0+/-, DC1+/-, DC2+/-, DC3+/-, DC4+/-, CKC+/-, DD0+/-, DD1+/-, DD2+/-, DD3+/-, DD4+/-, CKD+/-

*2: LVDS signals should be measured at the terminal of 100 Ω resistance.

Note1: If there is a voltage variation (voltage drop) at the rising edge of VDD below 10.8V, there is a possibility that a product does not work due to a protection circuit.

Note2: LVDS signals must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.

If some of signals are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and function signals, VDD also must be shut down.

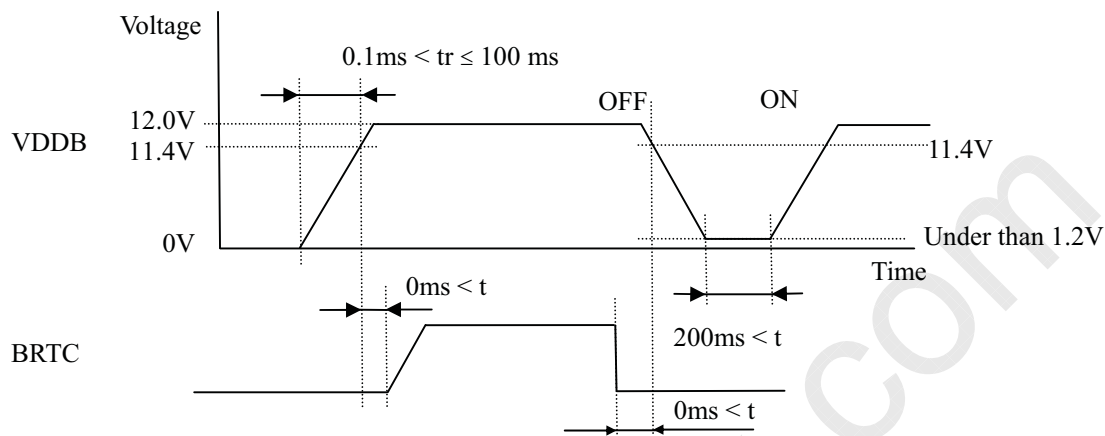
Note3: The backlight should be turned on within the turn-on period, in order to avoid unstable data display. ☆

Note4: After turning VDD on, terminal voltages on LVDS input terminals (*1) will rise. This is caused by initial operation of the product. ☆

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4.4.2 LED driver board



Note1: If t_r is more than 100 ms, the backlight will be turned off by a protection circuit for LED driver board. ☆

Note2: When VDDB is 0V or BRTC is Low, PWSEL must be set to Low or Open.



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4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): FI-RE51S-HF (Japan Aviation Electronics Industry Limited (JAE))

Adaptable plug: FI-RE51HL (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note1
2	GND	Ground	
3	GND	Ground	
4	DA0-	Pixel data A0	LVDS differential data input Note2
5	DA0+		
6	GND	Ground	Note1
7	DA1-	Pixel data A1	LVDS differential data input Note2
8	DA1+		
9	GND	Ground	Note1
10	DA2-	Pixel data A2	LVDS differential data input Note2
11	DA2+		
12	GND	Ground	Note1
13	CKA-	Pixel clock A	LVDS differential data input Note2
14	CKA+		
15	GND	Ground	Note1
16	DA3-	Pixel data A3	LVDS differential data input Note2
17	DA3+		
18	GND	Ground	Note1
19	DA4-	Pixel data A4	LVDS differential data input Note2
20	DA4+		
21	GND	Ground	Note1
22	DB0-	Pixel data B0	LVDS differential data input Note2
23	DB0+		
24	GND	Ground	Note1
25	DB1-	Pixel data B1	LVDS differential data input Note2
26	DB1+		
27	GND	Ground	Note1
28	DB2-	Pixel data B2	LVDS differential data input Note2
29	DB2+		
30	GND	Ground	Note1
31	CKB-	Pixel clock B	LVDS differential data input Note2
32	CKB+		
33	GND	Ground	Note1
34	DB3-	Pixel data B3	LVDS differential data input Note2
35	DB3+		
36	GND	Ground	Note1
37	DB4-	Pixel data B4	LVDS differential data input Note2
38	DB4+		
39	GND	Ground	Note1

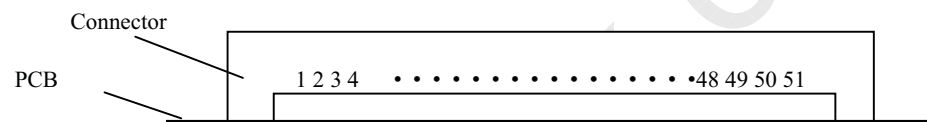
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40	GND	Ground	Note1
41	RSEV	-	Keep this pin Open.
42	RSEV	-	Keep this pin Open.
43	RSEV	-	Keep this pin Open.
44	RSEV	-	Keep this pin Open.
45	GND	Ground	Note1
46	GND	Ground	Note1
47	GND	Ground	Note1
48	RSEV	-	Keep this pin Open.
49	RSEV	-	Keep this pin Open.
50	RSEV	-	Keep this pin Open.
51	GND	Ground	Note1

CN1: Insert surface side



Note1: All GND terminals should be used without any non-connected lines.

Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.



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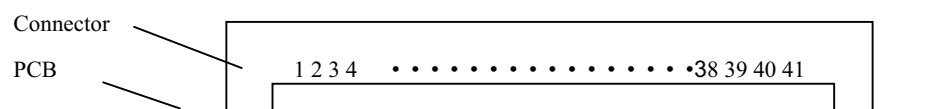
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CN2 socket (LCD module side): FI-RE41S-HF (Japan Aviation Electronics Industry Limited (JAE))

Adaptable plug: FI-RE41HL (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note1
2	GND	Ground	
3	GND	Ground	
4	DC0-	Pixel data C0	LVDS differential data input Note2
5	DC0+		
6	GND	Ground	Note1
7	DC1-	Pixel data C1	LVDS differential data input Note2
8	DC1+		
9	GND	Ground	Note1
10	DC2-	Pixel data C2	LVDS differential data input Note2
11	DC2+		
12	GND	Ground	Note1
13	CKC-	Pixel clock C	LVDS differential data input Note2
14	CKC+		
15	GND	Ground	Note1
16	DC3-	Pixel data C3	LVDS differential data input Note2
17	DC3+		
18	GND	Ground	Note1
19	DC4-	Pixel data C4	LVDS differential data input Note2
20	DC4+		
21	GND	Ground	Note1
22	DD0-	Pixel data D0	LVDS differential data input Note2
23	DD0+		
24	GND	Ground	Note1
25	DD1-	Pixel data D1	LVDS differential data input Note2
26	DD1+		
27	GND	Ground	Note1
28	DD2-	Pixel data D2	LVDS differential data input Note2
29	DD2+		
30	GND	Ground	Note1
31	CKD-	Pixel clock D	LVDS differential data input Note2
32	CKD+		
33	GND	Ground	Note1
34	DD3-	Pixel data D3	LVDS differential data input Note2
35	DD3+		
36	GND	Ground	Note1
37	DD4-	Pixel data D4	LVDS differential data input Note2
38	DD4+		
39	GND	Ground	Note1
40	GND	Ground	Note1
41	GND	Ground	Note1

CN2: Insert surface side



Note1: All GND terminals should be used without any non-connected lines.

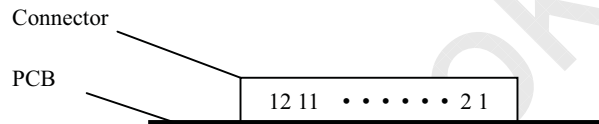
Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

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CN3 socket (LCD module side): IL-Z-12PL-SMTYE (Japan Aviation Electronics Industry Limited (JAE))
Adaptable plug: IL-Z-12S-S125C (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	Function	Description
1	VDD	Power supply	Note1
2	VDD		
3	VDD		
4	VDD		
5	VDD		
6	VDD		
7	GND	Signal ground	Note1
8	GND		
9	GND		
10	GND		
11	GND		
12	GND		

CN3: Insert surface side



Note1: All VDD and GND terminals should be used without any non-connected lines.

4.5.2 LED driver board

CN201 socket (LCD module side): DF3Z-10P-2H (2*) (HIROSE ELECTRIC Co.,Ltd.)
Adaptable plug: DF3-10S-2C (HIROSE ELECTRIC Co.,Ltd.)

Pin No.	Symbol	Function	Description
1	GNDB	LED driver board ground	Note1
2	GNDB		
3	GNDB		
4	GNDB		
5	GNDB		
6	VDDB	Power supply	Note1
7	VDDB		
8	VDDB		
9	VDDB		
10	VDDB		

Note1: All VDDB and GNDB terminals should be used without any non-connected lines.

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CN202 socket (LCD module side): IL-Z-9PL-SMTYE (Japan Aviation Electronics Industry Limited (JAE))
Adaptable plug: IL-Z-9S-S125C3 (Japan Aviation Electronics Industry Limited (JAE))

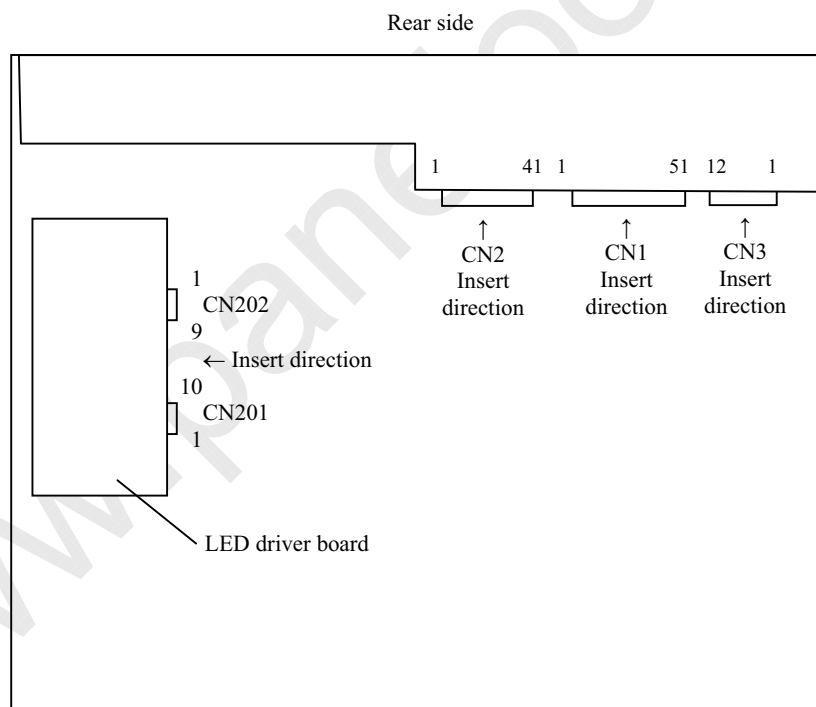
Pin No.	Symbol	Function	Description
1	GNDB	LED driver board ground	Note1
2	GNDB		
3	N.C.	-	Keep this pin Open.
4	BRTC	Backlight ON/OFF control signal	High or Open: Backlight ON Low: Backlight OFF
5	BRTH	Luminance control terminal	Note2
6	BRTI		
7	BRTP	BRTP signal	Note1
8	GNDB	LED driver board ground	
9	PWSEL	Selection of luminance control signal method	Note2, Note3

Note1: All GNDB terminals should be used without any non-connected lines.

Note2: See "4.6 LUMINANCE CONTROL".

Note3: When VDDB is 0V or BRTC is Low, PWSEL must be set to Low or Open.

4.5.3 Positions of socket



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4.6 LUMINANCE CONTROL

4.6.1 Luminance control methods

Method	Adjustment and luminance ratio	PWSEL terminal	B RTP terminal
Variable resistor control Note1	<		

Note1: In case of the variable resistor control method and the voltage control method, noises may appear on the display image depending on the input signals timing for LCD panel signal processing board.

Use PWM method, if interference noises appear on the display image!

Note2: The LED driver board will stop working, if the Low period of B RTP signal is more than 50ms while BRTC signal is High or Open. Then the backlight will not turn on anymore, even if B RTP signal is input again. This is not out of order. The LED driver board will start to work when power is supplied again.

Note3: These data are the target values.

Note4: See "4.6.2 Detail of B RTP timing".

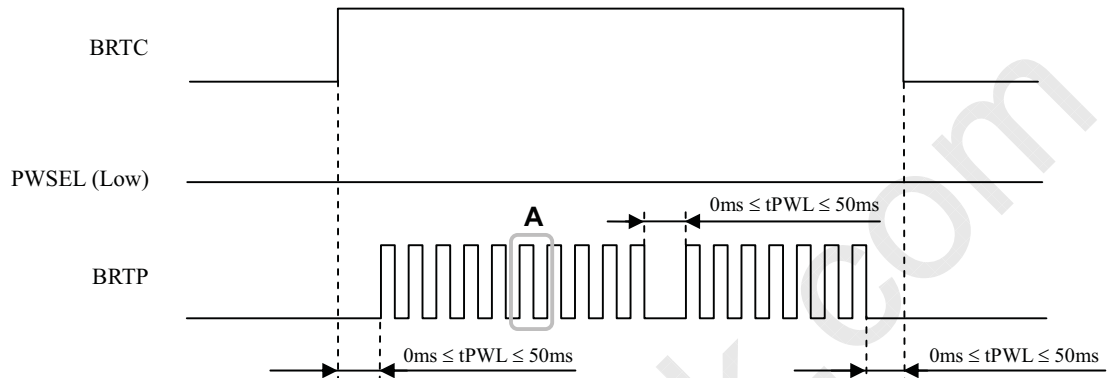
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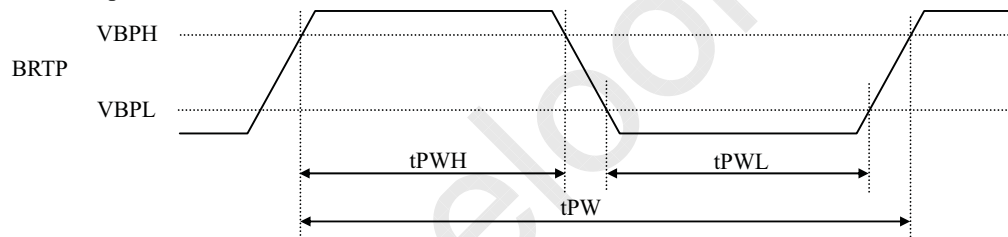
4.6.2 Detail of BRTP timing

(1) Timing diagrams

• Outline chart



• Detail of A part



(2) Each parameter

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
PWM frequency	f_{PWM}	185	-	1,000	Hz	Note1,2,3
PWM duty ratio	DR_{PWM}	1	-	100	%	Note4,5
PWM pulse width	tPWH	30	-	-	μs	Note1,4,5

Note1: Definition of parameters is as follows.

$$f_{\text{PWM}} = \frac{1}{t_{\text{PW}}} , \quad \text{DL} = \frac{t_{\text{PWH}}}{t_{\text{PW}}}$$

Note2: A recommended f_{PWM} value is as follows.

$$f_{\text{PWM}} = \frac{2n-1}{4} \times f_v$$

(n= integer, f_v = frame frequency of LCD module)

Note3: Depending on the frequency used, so noise may appear on the screen, please conduct a thorough evaluation.

Note4: While the BRTC signal is high, do not set the tPWH (PWM pulse width) is less than 30 μs . It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by BRTC signal.

Note5: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.



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4.7 METHOD OF CONNECTION FOR LVDS TRANSMITTER

	Bit mapping	Transmitter Pin Assign		Output Connector		CNI	
		Single type LVDS Tx	Dual type LVDS Tx Thine THC63LVD1023B			Pin No.	Signal Name
odd Pixel data A	RA4	TA0	R14	ATA-	→	-	-
	RA5	TA1	R15			4	DA0-
	RA6	TA2	R16			5	DA0+
	RA7	TA3	R17			-	-
	RA8	TA4	R18	ATB-	→	7	DA1-
	RA9	TA5	R19			8	DA1+
	GA4	TA6	G14			-	-
	GA5	TB0	G15			-	-
	GA6	TB1	G16	ATC-	→	10	DA2-
	GA7	TB2	G17			11	DA2+
	GA8	TB3	G18			-	-
	GA9	TB4	G19			-	-
	BA4	TB5	B14	ATD-	→	16	DA3-
	BA5	TB6	B15			17	DA3+
	BA6	TC0	B16			-	-
	BA7	TC1	B17			-	-
	BA8	TC2	B18	ATE-	→	19	DA4-
	BA9	TC3	B19			20	DA4+
	Hsync	TC4	Hsync			-	-
	Vsync	TC5	Vsync			-	-
	DE	TC6	DE	ATCLK- ATCLK+	→	13	CKA-
	RA2	TD0	R12			14	CKA+
	RA3	TD1	R13			-	-
	GA2	TD2	G12			22	DB0-
	GA3	TD3	G13	BTA+	→	23	DB0+
	BA2	TD4	B12			-	-
	BA3	TD5	B13			25	DB1-
	N.C.	TD6	-			26	DB1+
	RA0	TE0	R10	BTB-	→	-	-
	RA1	TE1	R11			28	DB2-
	GA0	TE2	G10			29	DB2+
	GA1	TE3	G11			-	-
even Pixel data B	BA0	TE4	B10	BTC-	→	34	DB3-
	BA1	TE5	B11			35	DB3+
	N.C.	TE6	-			-	-
	CLK	CLK	CLK			-	-
	RB4	TA0	R14	BTD-	→	37	DB4-
	RB5	TA1	R15			38	DB4+
	RB6	TA2	R16			-	-
	RB7	TA3	R17			31	CKB-
	RB8	TA4	R18	BTE-	→	32	CKB+
	RB9	TA5	R19			-	-
	GB4	TA6	G14			-	-
	GB5	TB0	G15	BTC+	→	-	-
	GB6	TB1	G16			-	-
	GB7	TB2	G17			-	-
	GB8	TB3	G18			-	-
	GB9	TB4	G19	BTD+	→	-	-
	BB4	TB5	B14			-	-
	BB5	TB6	B15			-	-
	BB6	TC0	B16			-	-
	BB7	TC1	B17	BTE+	→	-	-
	BB8	TC2	B18			-	-
	BB9	TC3	B19			-	-
	Hsync	TC4	Hsync			-	-
	Vsync	TC5	Vsync	BTCLK- BTCLK+	→	-	-
	DE	TC6	DE			-	-
	RB2	TD0	R12			-	-
	RB3	TD1	R13			-	-
	GB2	TD2	G12	BTE-	→	-	-
	GB3	TD3	G13			-	-
	BB2	TD4	B12			-	-
	BB3	TD5	B13			-	-
	N.C.	TD6	-	BTE+	→	-	-
	RB0	TE0	R10			-	-
	RB1	TE1	R11			-	-
	GB0	TE2	G10			-	-
	GB1	TE3	G11	BTCLK- BTCLK+	→	-	-
	BB0	TE4	B10			-	-
	BB1	TE5	B11			-	-
	N.C.	TE6	-			-	-
	CLK	CLK	CLK			-	-



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	Bit mapping	Transmitter Pin Assign		Output Connector		CN2	
		Single type LVDS Tx	Dual type LVDS Tx Thine THC63LVD1023B			Pin No.	Signal Name
odd Pixel data C	RC4	TA0	R14	CTA-	→	-	-
	RC5	TA1	R15			4	DC0-
	RC6	TA2	R16			5	DC0+
	RC7	TA3	R17			-	-
	RC8	TA4	R18			7	DC1-
	RC9	TA5	R19	CTB-	→	8	DC1+
	GC4	TA6	G14			-	-
	GC5	TB0	G15			-	-
	GC6	TB1	G16			-	-
	GC7	TB2	G17			-	-
	GC8	TB3	G18	CTC-	→	10	DC2-
	GC9	TB4	G19			11	DC2+
	BC4	TB5	B14			-	-
	BC5	TB6	B15			-	-
	BC6	TC0	B16	CTC+	→	-	-
	BC7	TC1	B17			-	-
	BC8	TC2	B18			-	-
	BC9	TC3	B19			-	-
	Hsync	TC4	Hsync			-	-
	Vsync	TC5	Vsync	CTD-	→	16	DC3-
	DE	TC6	DE			17	DC3+
	RC2	TD0	R12			-	-
	RC3	TD1	R13	CTD+	→	-	-
	GC2	TD2	G12			19	DC4-
	GC3	TD3	G13			20	DC4+
	BC2	TD4	B12			-	-
	BC3	TD5	B13	CTE-	→	-	-
	N.C.	TD6	-			-	-
	RC0	TE0	R10			-	-
	RC1	TE1	R11	CTE+	→	13	CKC-
	GC0	TE2	G10			14	CKC+
	GC1	TE3	G11			-	-
	BC0	TE4	B10			-	-
	BC1	TE5	B11	CTCLK- CTCLK+	→	-	-
	N.C.	TE6	-			-	-
	CLK	CLK	CLK			-	-
even Pixel data D	RD4	TA0	R14	DTA-	→	-	-
	RD5	TA1	R15			23	DD0+
	RD6	TA2	R16			-	-
	RD7	TA3	R17	DTB-	→	25	DD1-
	RD8	TA4	R18			26	DD1+
	RD9	TA5	R19			-	-
	GD4	TA6	G14	DTB+	→	-	-
	GD5	TB0	G15			-	-
	GD6	TB1	G16			-	-
	GD7	TB2	G17			-	-
	GD8	TB3	G18	DTC-	→	28	DD2-
	GD9	TB4	G19			29	DD2+
	BD4	TB5	B14			-	-
	BD5	TB6	B15			-	-
	BD6	TC0	B16	DTC+	→	-	-
	BD7	TC1	B17			-	-
	BD8	TC2	B18			-	-
	BD9	TC3	B19			-	-
	Hsync	TC4	Hsync	DTD-	→	34	DD3-
	Vsync	TC5	Vsync			35	DD3+
	DE	TC6	DE			-	-
	RD2	TD0	R12			-	-
	RD3	TD1	R13	DTD+	→	-	-
	GD2	TD2	G12			-	-
	GD3	TD3	G13			-	-
	BD2	TD4	B12			-	-
	BD3	TD5	B13	DTE-	→	37	DD4-
	N.C.	TD6	-			38	DD4+
	RD0	TE0	R10			-	-
	RD1	TE1	R11			-	-
	GD0	TE2	G10	DTE+	→	31	CKD-
	GD1	TE3	G11			32	CKD+
	BD0	TE4	B10			-	-
	BD1	TE5	B11			-	-
	N.C.	TE6	-	DTCLK- DTCLK+	→	-	-
	CLK	CLK	CLK			-	-

Note1: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

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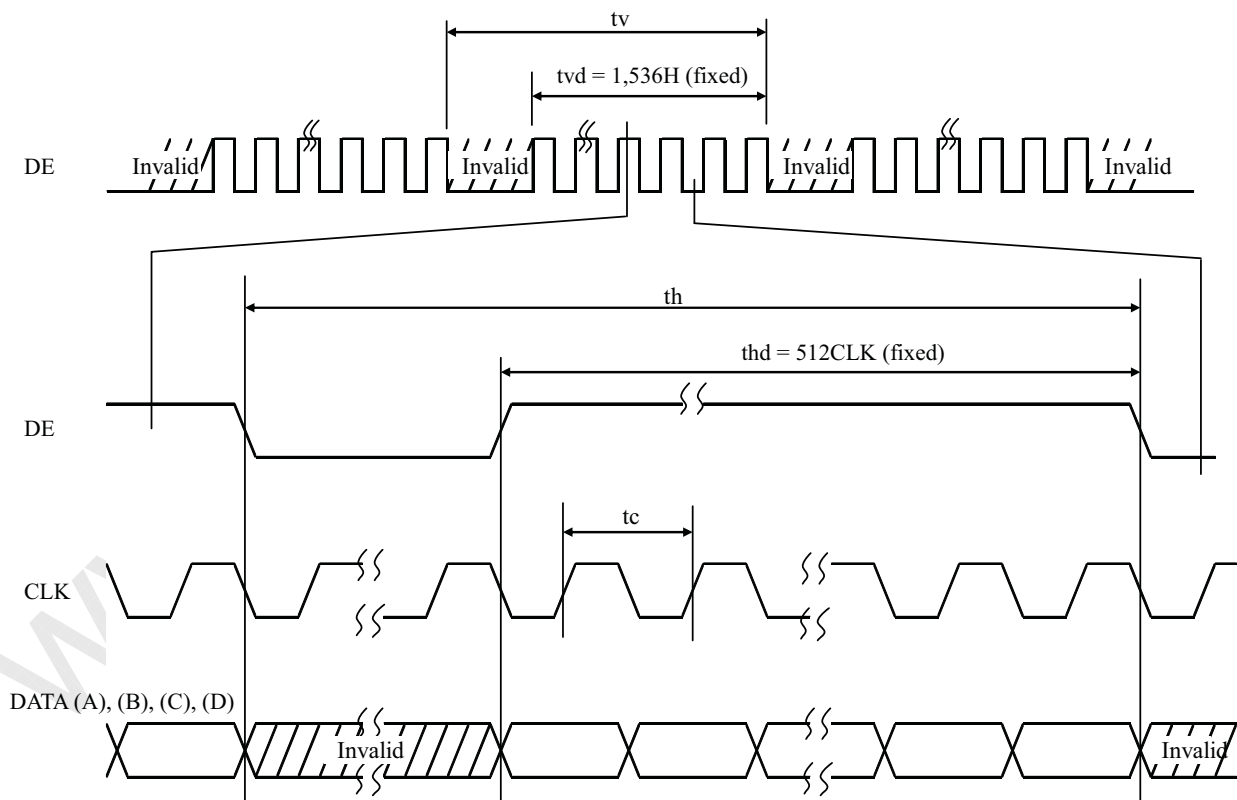
This product can display 1,073,741,824 colors equivalent with 1,024 gray scale in each R, G, B sub-pixel. Also the relation between display colors and input data signals is as follows.

Green gray scale	dark	0 0 0 0 0 0 0
	↑	0 0 0 0 0 0 0
		:
	↓	:
	bright	0 0 0 0 0 0 0
	0 0 0 0 0 0 0	
	0 0 0 0 0 0 0	
	0 0 0 0 0 0 0	
	0 0 0 0 0 0 0	
Blue gray scale	Black	0 0 0 0 0 0 0
		0 0 0 0 0 0 0
	dark	0 0 0 0 0 0 0
	↑	:
		:
	↓	0 0 0 0 0 0 0
	bright	0 0 0 0 0 0 0
	0 0 0 0 0 0 0	
	0 0 0 0 0 0 0	
	0 0 0 0 0 0 0	

NLT Technologies, Ltd.**NL204153AC21-17****4.9 INPUT SIGNAL TIMINGS****4.9.1 Timing characteristics**

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/ tc	60.0	65.0	66.0	MHz	-
	Duty		-	See the data sheet of LVDS transmitter.			-	-
	Rise time, Fall time		-				ns	-
DE	Horizontal	Cycle	th	10.34	10.34	10.77	μs	96,72kHz(typ.) Note1
				640	672	700	CLK	
		Display period	thd	512			CLK	-
	Vertical	Cycle	tv	15.47	16.667	17.9	ms	60.0Hz(typ.)
				1547	1612	1628	H	
		Display period	tvd	1536			H	-
	CLK-DE	Setup time	-	See the data sheet of LVDS transmitter.			ns	-
		Hold time	-				ns	-
Rise time, Fall time		-				ns	-	

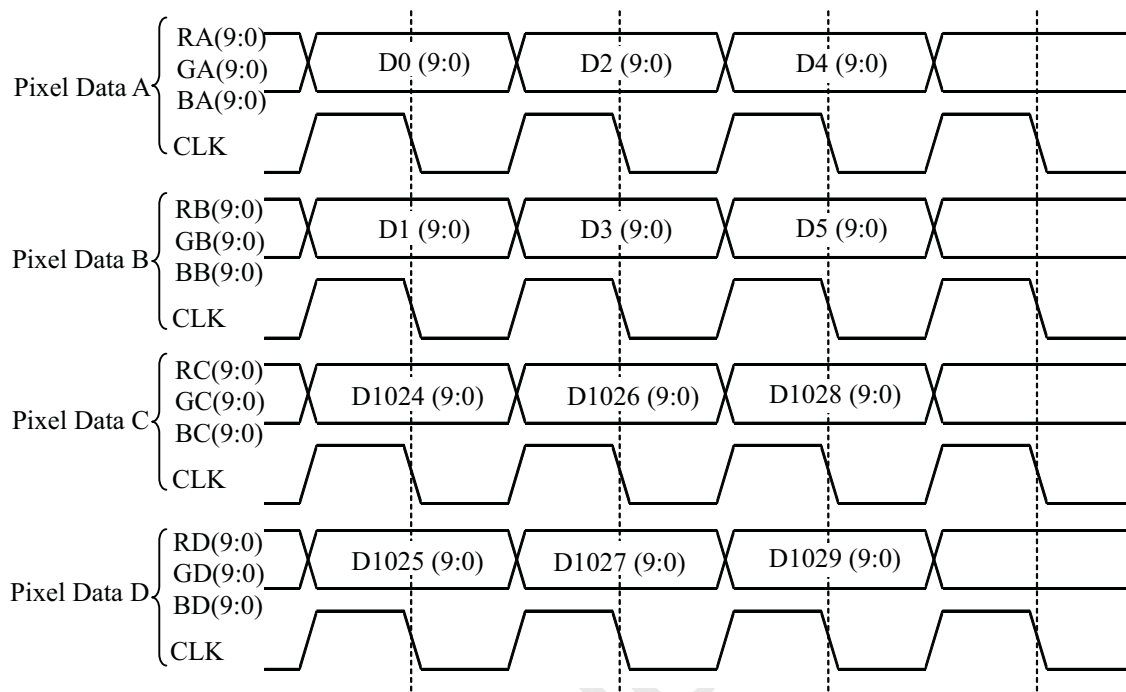
Note1: The sum of jitter and skew of horizontal period should be within ± 1 CLK.

4.9.2 Input signal timing chart

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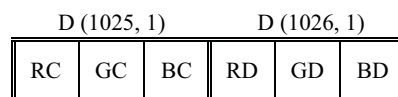
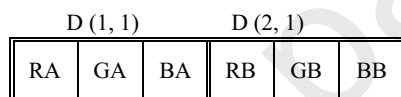
4.10 LVDS DATA TRANSMISSION METHOD



4.11 DISPLAY POSITIONS

Odd pixel: RA,RC= Red date
GA,GC=Green date
BA,BC=Blue date

Even pixel: RB,RD=Red date
GB,GD=Green date
BB,BD=Blue date



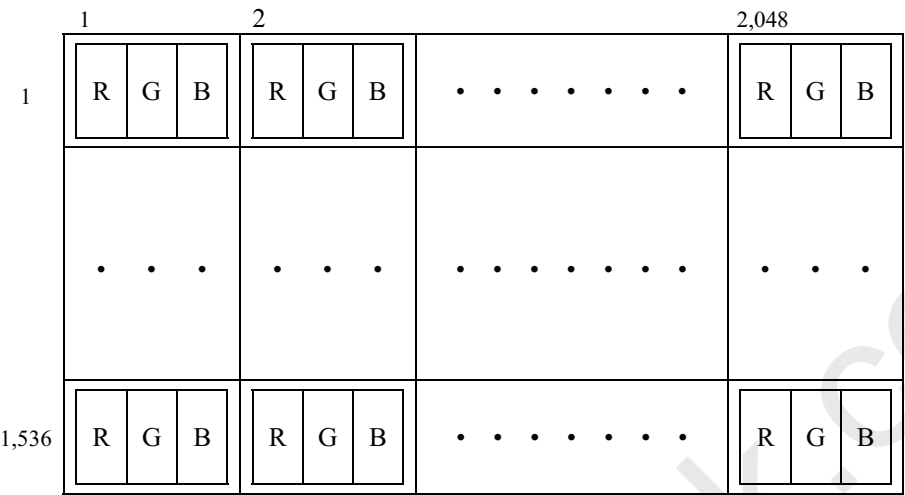
1, 1	2, 1	...	1023, 1	1024, 1	1025, 1	1026, 1	...	2047, 1	2048, 1
1, 2	2, 2	...	1023, 2	1024, 2	1025, 2	1026, 2	...	2047, 2	2048, 2
...	...	...	...	...	...	...	...	...	...
1, 1535	2, 1535	...	1023, 1535	1024, 1535	1025, 1535	1026, 1535	...	2047, 1535	2048, 1535
1, 1536	2, 1536	...	1023, 1536	1024, 1536	1025, 1536	1026, 1536	...	2047, 1536	2048, 1536



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4.12 PIXEL ARRANGNMENT



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4.13 OPTICS

4.13.1 Optical characteristics

(Note1, Note2)

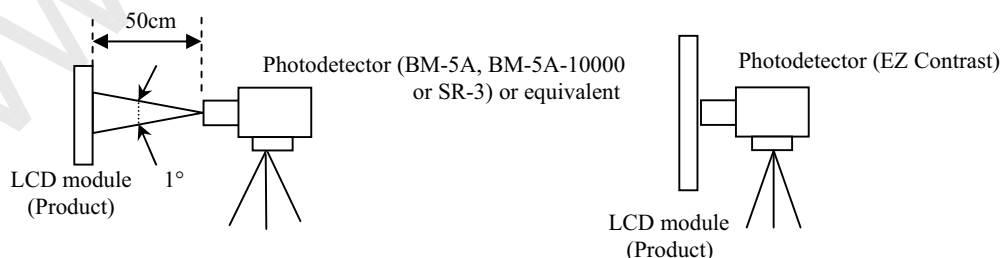
Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	600	800	-	cd/m ²	BM-5A or SR-3	Note3
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	1,000	1,400	-	-	BM-5A or SR-3	Note3 Note5
Luminance uniformity		White θR = 0°, θL = 0°, θU = 0°, θD = 0°	LU	80	-	-	%	BM-5A or SR-3	Note4 Note6
Chromaticity	White	x coordinate	Wx	0.269	0.299	0.329	-	SR-3	Note3 Note7
		y coordinate	Wy	0.285	0.315	0.345	-		
	Red	x coordinate	Rx	-	0.65	-	-		
		y coordinate	Ry	-	0.33	-	-		
	Green	x coordinate	Gx	-	0.29	-	-		
		y coordinate	Gy	-	0.60	-	-		
	Blue	x coordinate	Bx	-	0.15	-	-		
		y coordinate	By	-	0.07	-	-		
Color gamut		θR = 0°, θL = 0°, θU = 0°, θD = 0° at center, against NTSC color space	C	65	72	-	%	SR-3	Note3
Response time		Black to White	Ton	-	20	30	ms	BM-5A -10000	Note8 Note9
		White to Black	Toff	-	20	30	ms		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10	θR	70	88	-	°	BM-5A or EZ Contrast	Note3 Note10
	Left	θU= 0°, θD= 0°, CR≥ 10	θL	70	88	-	°		
	Up	θR= 0°, θL= 0°, CR≥ 10	θU	70	88	-	°		
	Down	θR= 0°, θL= 0°, CR≥ 10	θD	70	88	-	°		

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VDD= 12.0V, VDDB= 12.0V, PWM: Duty 100%, Display mode: QXGA,
Horizontal cycle= 1/96.72 kHz, Vertical cycle= 1/60.0 Hz

Optical characteristics are measured at luminance saturation 20minutes after the product works in the dark room. Also measurement methods are as follows.



Note3: Product surface temperature TopF= 32°C, TopR= 43°C (at the maximum luminance control)

Note4: Product surface temperature TopF= 30°C, TopR= 38°C (at the product luminance 450cd/m²)

LU is measured under the condition of temperature differences in the display area are less than 10°C

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Note5: See "4.13.2 Definition of contrast ratio".

Note6: See "4.13.3 Definition of luminance uniformity".

Note7: These coordinates are found on CIE 1931 chromaticity diagram.

Note8: See "4.13.4 Definition of response times".

Note9: Product surface temperature TopF = 35°C

Note10: See "4.13.5 Definition of viewing angles".



4.13.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

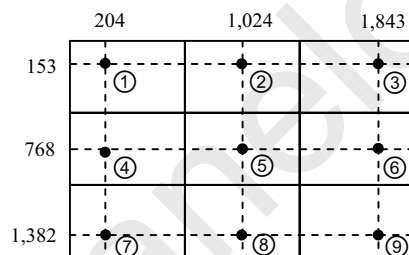
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.13.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from ① to ⑨}}{\text{Maximum luminance from ① to ⑨}}$$

The luminance is measured at near the 9 points shown below.

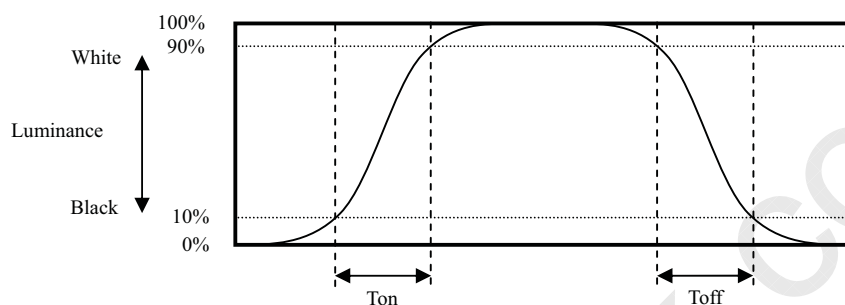


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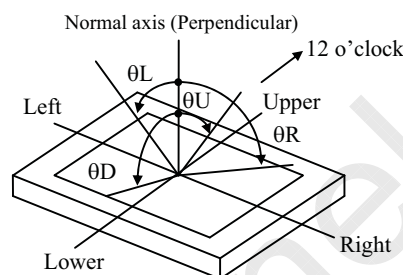
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4.13.4 Definition of response times

Response time is measured at the time when the luminance changes from "black" to "white", or "white" to "black" on the same screen point, by photo-detector. Ton is the time when the luminance changes from 10% up to 90%. Also Toff is the time when the luminance changes from 90% down to 10% (See the following diagram.).



4.13.5 Definition of viewing angles



5. ESTIMATED LUMINANCE LIFETIME

The luminance lifetime is the time from initial luminance to half-luminance.

This lifetime is the estimated value, and is not guarantee value.

Condition		Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3	Unit
LED elementary substance	25°C (Ambient temperature of the product) Continuous operation, PWM: Duty 100%	70,000	h
	60°C (Temperature of the product front or rear panel) Continuous operation, PWM: Duty 100%	60,000	

Note1: Life time expectancy is mean time to half-luminance.

Note2: Estimated luminance lifetime is not the value for LCD module but the value for LED elementary substance.

Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

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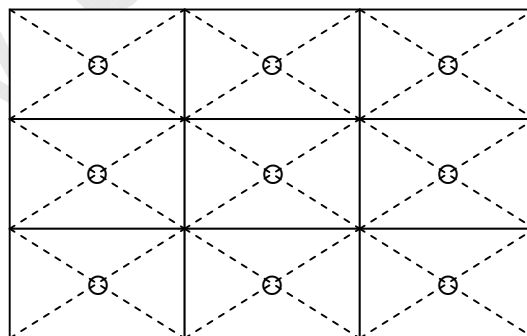
6. RELIABILITY TESTS

Test item		Condition	Judgment Note1
High temperature and humidity (Operation)		① $60 \pm 2^{\circ}\text{C}$, RH= 60%, 240hours ② Display data is white. Note2	No display malfunctions
Heat cycle (Operation)		① $0 \pm 3^{\circ}\text{C}$ 1hour $60 \pm 3^{\circ}\text{C}$ 1hour ② 50cycles, 4hours/cycle ③ Display data is white. Note2	
Thermal shock (Non operation)		① $-20 \pm 3^{\circ}\text{C}$ 30minutes $60 \pm 3^{\circ}\text{C}$ 30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
Vibration (Non operation)		① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 10 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)		① 294m/s^2 , 11ms ② X, Y, Z directions ③ 3 times each directions	
ESD (Operation)		① 150pF, 150Ω , $\pm 10\text{kV}$ ② 9 places on a panel surface Note3 ③ 10 times each places at 1 sec interval	No display malfunctions
Low pressure	Non-operation	① 15kPa (Equivalent to altitude 13,600m) ② $-20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ 24 hours ③ $+60^{\circ}\text{C} \pm 3^{\circ}\text{C}$ 24 hours	No display malfunctions
	Operation	① 53.3kPa (Equivalent to altitude 5,100m) ② $0^{\circ}\text{C} \pm 3^{\circ}\text{C}$ 24 hours ③ $+60^{\circ}\text{C} \pm 3^{\circ}\text{C}$ 24 hours Note2	

Note1: Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect criteria.

Note2: Luminance: 450cd/m^2 at luminance control.

Note3: See the following figure for discharge points



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7. PRECAUTIONS

7.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "7.2 CAUTIONS" and "7.3 ATTENTIONS"!**



This sign has the meaning that a customer will be injured or the product will sustain damage if the customer practices wrong operations.



This sign has the meaning that a customer will be injured if the customer practices wrong operations.

7.2 CAUTIONS



*** Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: Equal to or no greater than 294m/s^2 and equal to or no greater than 11ms, Pressure: Equal to or no greater than 19.6N ($\phi 16\text{mm}$ jig))**



7.3 ATTENTIONS

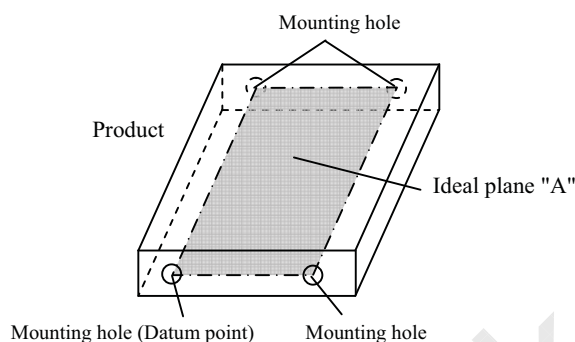
7.3.1 Handling of the product

- ① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
- ② Do not hook or pull cables such as lamp cable, and so on, in order to avoid any damage.
- ③ When the product is put on the table temporarily, display surface must be placed downward.
- ④ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
- ⑤ The torque for product mounting screws must never exceed 0.735N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be $\leq 5.0\text{mm}$.

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- ⑥ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
Recommended installing method: Ideal plane "A" is defined by one mounting hole (datum point) and other mounting holes. The ideal plane "A" should be the same plane within ± 0.3 mm.



- ⑦ Do not press or rub on the sensitive product surface. When cleaning the product surface, wipe it with a soft dry cloth.
⑧ Do not push or pull the interface connectors while the product is working.
⑨ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.
⑩ Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal by any chance, please wash it away with soap and water.

7.3.2 Environment

- ① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
② In order to prevent dew condensation occurred by temperature difference, the product packing box must be opened after enough time being left under the environment of an unpacking room. Evaluate the storage time sufficiently because dew condensation is affected by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with the original packing state after a customer receives the package)
③ Do not operate in high magnetic field. If not, circuit boards may be broken.
④ This product is not designed as radiation hardened.

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7.3.3 Characteristics

The following items are neither defects nor failures.

- ① Response time, luminance and color may be changed by ambient temperature.
- ② Display mura, flickering, vertical streams or tiny spots may be observed depending on display patterns.
- ③ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
- ④ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.
- ⑤ Optical characteristics may be changed depending on input signal timings.

7.3.4 Others

- ① All GND, GNDB, VDD and VDDB terminals should be used without any non-connected lines.
- ② Do not disassemble a product or adjust variable resistors.
- ③ Pack the product with the original shipping package, in order to avoid any damages during transportation, when returning the product to NLT for repairing and so on.
- ④ The LCD module by itself or integrated into end product should be packed and transported with display in the vertical position. Otherwise the display characteristics may be degraded.
- ⑤ The information of China RoHS directive six hazardous substances or elements in this product is as follows.

China RoHS directive six 1 hazardous substances or elements					
Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr VI)	Polybrominated Biphenys (PBB)	Polybrominated Biphenyl Ethers (PBDE)
×	○	○	○	○	○

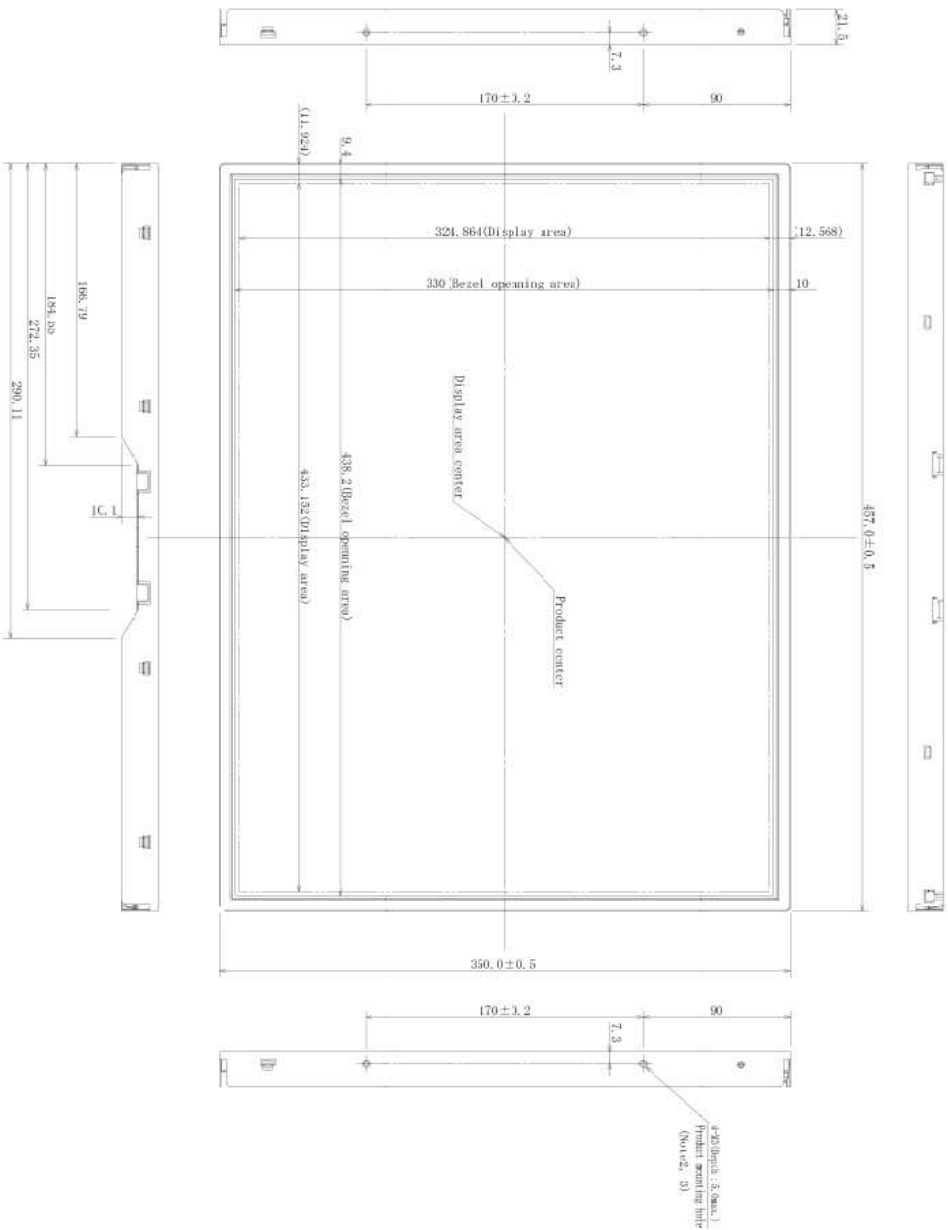
Note1: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of SJ/T11363-2006 standard regulation.

×: This indicates that the poisonous or harmful material in all the homogeneous

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8. OUTLINE DRAWINGS

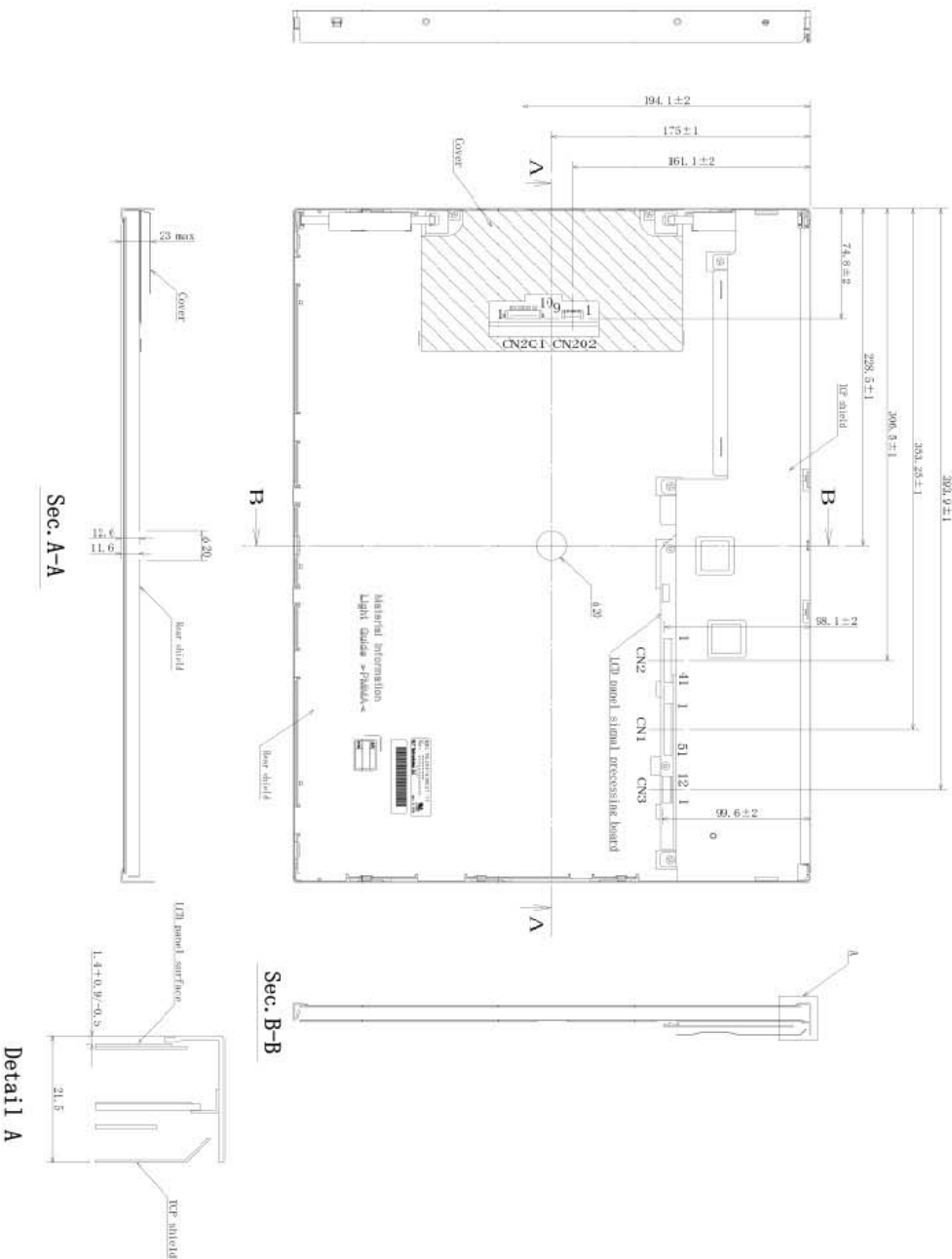
8.1 FRONT VIEW



Note1: Not shown tolerances of the dimensions are $\pm 0.5\text{mm}$
Note2: The torque for product mounting screws must never exceed $0.735\text{N}\cdot\text{m}$
Note3: The length of product mounting screws from surface of plate must be $\leq 5.0\text{mm}$
Note4: The values in parentheses are for reference.

Unit: mm

8.2 REAR VIEW



Note1: Not shown tolerances of the dimensions are ±0.5mm.
Note2: The torque for product mounting screws must never exceed 0.735N·m.
Note3: The length of product mounting screws from surface of plate must be ≤ 5.0mm.
Note4: The values in parentheses are for reference.

Unit: mm